Department of Agriculture, Trade and Consumer Protection
Division of Agricultural Development
Agricultural Development & Diversification Program (ADD)
Grant Project Final Report

Contract Number: 21056

Grant Project Title: Developing High Methionine Corn for Organic Poultry Producers

Amount of Funding Awarded: $30,000

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Please use the following questions as a guide for writing your grant project final report. In your final report, please answer each question as it relates to your grant project.

1) What was the original intent of the grant?

What did you want to accomplish with the grant? The project as a whole was concerned with developing high methionine corn as a viable crop and feedstuff for organic poultry farmers. Funding from DATCP was mostly used for breeding and testing methionine content of corn cultivars and for developing an NIR testing method for methionine and other essential amino acids.

How was it expected to benefit Wisconsin Agriculture? Our target is to help organic poultry producers in Wisconsin. According to USDA/ERS figures, organic layer and egg production in the Nation has tripled between 2000 and 2003 and it may still be increasing at an exponential rate. In 2003, ERS found that almost 40% of that production was located in Wisconsin, Iowa, and Minnesota. Major organic poultry and egg companies in Wisconsin include Farmers Organic Foods, Organic Valley/Organic Prairie, Egg Innovations, and Chino Valley Producers. The sulfur containing amino acids (methionine and cysteine) are the first limiting amino acids for poultry health and egg production, and of the two amino acids, feeders generally focus on methionine because it is more prevalent in common feeds. Poultry feed should contain approximately 0.4% methionine over the lifespan of the animal (personal communication, Dr. Mark Cook, Poultry Nutritionist, UW Madison), and this need is met in feeds based on corn and soybeans by supplementing with synthetic DL methionine. Corn is the major component of chicken feed. It contains approximately 0.21% methionine, but this level can be increased by breeding. Though such improvement may be of marginal interest for conventional feeders, it is highly pertinent for organic poultry producers as synthetic methionine currently comprises about 0.1% of the ration and USDA may not allow them to feed synthetic methionine after October, 2008. High methionine corn may be the most sensible way to meet this need as other natural sources of methionine are expensive and imported.

What makes this project work important or significant? The project represents a team effort involving MFAI, USDA/ARS, Organic Valley Coop, and the University of Minnesota, that is addressing and resolving the methionine issue on many fronts, including breeding, agronomic trials, feeding trials with chickens, and developing testing methods. The funding from DATCP was mainly used to develop the breeding and testing part of the project. In particular it allowed us to: 1) continue breeding and evaluating high methionine corn; 2) gain crucial information on the chemical methionine content of our

samples with high-pressure liquid chromatography; 3) develop an initial NIR calibration for quickly testing our samples for methionine content; and 4) assess the value of a microbial bioassay for testing methionine.

2) **What steps did you take to reach your goal?**
What worked? Our team strategy as outlined in the proposal worked well. We were able to breed, do agronomic and feeding trials, and to gather information.

What challenges did you face? Insufficient seed for testing caused us to have to multiply seed in Chile. We are always gambling on what will turn out to be the best hybrid combinations when we multiply seeds and presents financial difficulties. An initial scan using an NIR calibration from the University of MN showed that the calibration was unable to detect methionine in our floury-2 corn. This clued us into realizing that pre-existing commercial NIR calibrations were probably not going to work for us as floury-2 cultivars do not exist outside of our program and have not been tested. Thus we put our resources into developing a new calibration rather than testing and revising old calibrations.

What would you do differently? I think we did the best we could under the restraints we were operating under. In terms of the future we have to learn and allocate resources as we learn. Our *floury 2* source of high methionine are weak agronomically, we probably will invest more in bringing hard endosperm cultivars into commercial production.

2) What were you able to accomplish?
What are the results from this project?

- We increased seed of high methionine corn in Chile and made crosses. This was important to obtain enough seed for chemical analyses and agronomic trials.

- We compared the methionine content of different corn lines. Grain samples were sent to Iowa State University Grain Lab, to AimsBio, and to the University of Missouri for testing. Methionine and cysteine contents were evaluated with different methods. Results are shown in Appendices 1 and 2. Many samples were high in methionine. Using the quantitative HPLC test, normal corn hybrids generally have methionine contents of 0.2%, but our samples ranged as high as 0.39%. Using the bioassay, normal corn hybrids generally have turbidity readings of 0.1 in the bioassay, but our samples ranged as high as 0.21. Floury-2 cultivars generally were amongst the highest ranking for methionine and cysteine, but also ranked surprisingly high for lysine. However, several hard endosperm cultivars ranked ***very*** high in methionine as well.

- We evaluated and bred corn lines and populations. Thousands of crosses were carried out in order to improve them and evaluate them further. These crosses will provide seed stocks and analytical substrates for the coming year.

- To compare agronomic characteristics, field trials were carried out by MFAI on their organic farm in East Troy, Wisconsin, at the Iowa State University Farm in Ames, Iowa, and at the University of Minnesota Lamberton Research Station. Though field data is only partially available due to still being in process of harvesting plots, initial results show that a few hybrid combinations, especially of the hard endosperm type, may be comparable to conventional hybrids in their agronomic performance (see Appendix 3). Though our floury-2 hybrids do well in quality, they are presently lagging behind in terms of yield, grain moisture, and standing ability. However, we have some encouragement in continuing to use this gene by observing a new generation of crosses which yielded well in the breeding nursery in 2007.

- We assembled a unique data set composed of different kinds of corn that produce methionine in many different ways grown on multiple sites. Initial results suggest that we have broken the

traditionally strong correlation of amino acids with protein in normal corn hybrids which has precluded any reliable NIR test. In our data set, correlations between protein content and methionine or lysine content were relatively low (R^2=0.37 and 0.28 respectively), which enables us to develop a robust NIR calibration for detecting methionine and other valuable amino acids rather than simply re-estimating protein content, which is probably what all other calibrations do. Our initial run of an NIR calibration was valuable for predicting protein, methionine, cysteine, and lysine (R^2 values of 0.97, 0.69, 0.71, 0.81, respectively). The methionine values from the microbial bioassay also correlated well with the HPLC analysis of methionine (R^2 = 0.58). However, the bioassay values correlated poorly with the predicted values from the NIR calibration (R^2 = 0.29), suggesting that the two tests were estimating different grain characteristics. Though the microbial bioassay is a useful test, it may prove to be more expensive and cumbersome than the NIR test.

- We supplied feed for long term trials with layers carried out with Organic Valley and Dr. Jacquie Jacobs from Animal Science at the University of Minnesota. Results suggest that high methionine corn adequately replaces synthetic methionine in feed for layers, and that there is essentially no difference in egg production. Data on the trial is still confidential but may be obtained by contacting her at the following email address: Jacob150@umn.edu.

- We disseminated information back to all relevant partners in the work, and have planned to give a presentation on our results together with Organic Valley at the Upper Midwest Organic Farming Conference in Lacrosse next spring in the format of a workshop.

3) **What conclusions can you make based on project work the analysis of collected data?** High methionine corn can replace synthetic methionine in the diets of organic poultry. Initial results suggest that it may be possible to develop cultivars with comparable yields and agronomic characteristics to normal hybrids but with high grain methionine contents.

4) **What do you plan to do in the future as a result of this project?** Our plans are partly outlined in the second phase of the proposal which was funded by DATCP. However, we also intend to pursue marketing the high methionine corn, producing more seed, and carrying out more feeding trials.

5) **What information or additional resources are needed to commercially develop this enterprise?** More funding for research and development would be well spent for winter nurseries, for additional test sites in Wisconsin, for breeding activities, for continued testing of grain methionine content by the NIR test, and for additional feeding trials with poultry. This year we have begun to commercialize the production of hybrids with Prairie Hybrids company in Deere Grove, IL and intend to sell seed for production next year.

6) **How should the agricultural industry use the results from your grant project?** The organic poultry industry has a true interest in these activities and they should support the resolution of the methionine problem through their activities by supporting the recently formed Methionine Taskforce (consortium of organic poultry producers) and by further breeding and dissemination of seed of high methionine corn. In the coming years it will be important for them to invest both in feeding trials with and purchasing of high methionine corn.